Changing Perceptions

WEST VIRGINIA'S REPUTATION FOR BUILDING STEEL LONG-SPAN BRIDGES HAS BEGUN TO CHANGE AS IT GAINS SUCCESS WITH INNOVATIVE CONCRETE DESIGNS—AND REAPS THE TAX REVENUE BENEFITS

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The East Huntington Bridge, opened in 1985, features a precast, prestressed concrete cable-stayed design with only one tower and main spans of 900 and 608 ft. The bridge's structural system is lighter than earlier concrete cable-stayed bridges and was only the second one of its kind to be built in the United States. All Photos: West Virginia Department of Transportation.

West Virginia has long been known for its steel bridges. This is ironic, as more than half of the state's bridges (about 52%) are built with concrete girders, and a successful program has been developed for rapidly replacing short-span bridges using standardized concrete beams. But, the West Virginia Department of Transportation (WVDOT) has been less successful in letting contracts for long-span segmental concrete spans. Now that is beginning to change as new designs have created successful bridges for WVDOT and contractors. An added benefit from building with concrete to the state is greater tax revenues.

The West Virginia Department of Transportation operates with a central office, which handles larger, more complex structures, and 10 district offices. Each district bridge office includes engineers, designers, inspectors, and maintenance crews. For some time, each team has used adjacent concrete box-beam girders standardized for lengths of up to 100 ft. The team selects the length of the bridge from a chart and specifies the designated beams.

This approach allows districts to quickly create drawings for shorter-length bridges, leading to short-span projects being constructed with concrete box beams by default. Each district completes two or three such projects each year. Districts used to have on-staff construction teams, but today that work is performed by outside contractors.

Consultants work on larger projects when WVDOT is unable to handle the workload or a complicated design is required. In many cases, regardless of who designs the project, spread boxes and I-beams are used for concrete designs. Of the concrete bridges, which account for about 3711 out of the 7187 total, approximately 1420 (38%) feature reinforced concrete, while 2291 (62%) use prestressed concrete, mostly in box-beam designs.

Cable-Stayed Bridges

Consultants designed two West Virginia's most dramatic concrete bridges, both cable-stayed designs. The East Huntington Bridge, opened in 1985, features precast, prestressed concrete girders with main spans of 900 and

608 ft supported by a single concrete tower. Only the second of its kind in the United States when built, it features high-strength prestressed concrete edge beams and deck with steel floor beams in a hybrid arrangement. The approach structure is a cast-in-place single-cell segmental concrete box girder erected using balanced-cantilever construction.

A more recent cable-stayed bridge, the Bridge of Honor (also known as the Pomeroy-Mason Bridge) over the Ohio River was built in 2008 and features a cast-in-place concrete segmental design (see article in Summer 2008 issue of *ASPIRE*[SM]). It is somewhat unique in that it was designed and built by the Ohio Department of Transportation and then turned over to WVDOT for operation and maintenance, owing to an earlier agreement on interstate construction and to its location, primarily in West Virginia.

Steel designs were used previously for long spans for several reasons. Foremost is that contractors typically were more comfortable with steel for longer crossings, which was a difficult mindset to break. WVDOT designers have provided concrete alternatives in many instances, but in the past the steel option typically was chosen during the bidding process.

Kanawha River Bridge Shifts Paradigm

A new paradigm has been created with the construction of the Kanawha River Bridge, completed in 2010, which produced a record span for a cast-in-place segmental box-girder structure (see article in Winter 2009 issue of *ASPIRE*). The 2975-ft-long concrete design with a 760-ft-long main span was evaluated as the least expensive option, owing to the complex geometry.

When local contractors became aware of the design, they convinced WVDOT management to allow a steel alternative to be considered. But in the bidding stage, the concrete design still won because it was more cost-effective. It features spans of 144, 247, 295, 295, 460, 760, 540, and 209 ft. Spans 1 through 5, 7, and 8 have curved alignment, including a circular curve with a 1910-ft radius and a spiral transition. The box girder is post-tensioned in the longitudinal, transverse and vertical directions.

With this success, designers and contractors have seen the long-span effectiveness of concrete. They also can take advantage of a number of competitive suppliers in the state to provide expertise and components, as well as skilled laborers in the tristate area to work on the projects.

Concrete designs provide significant benefits for projects using accelerated bridge construction (ABC) techniques, as components can be fabricated away from the site and then delivered once the site is ready. WVDOT has used precast concrete deck panels on smaller bridges as well as precast concrete abutments and wing walls in addition to beams. Also, more ABC projects are being designed with concrete, as the material fits very well with faster schedules.

The Bridge of Honor over the Ohio River is a cast-in-place segmental concrete cable-stayed bridge designed and built by the Ohio Department of Transportation and then turned over to the West Virginia Department of Transportation for operation and maintenance.

In-State Tax Benefits

An additional part of WVDOT's interest in concrete designs comes from the added tax revenues. When a project is bid with concrete components, they are generally fabricated in the state, so the business and occupation taxes remain in the state. With a steel design, manufacturing occurs out of state, eliminating millions of dollars in revenue for materials and labor, and generating no job opportunities for the citizens of West Virginia.

Workers are guaranteed to be paid the prevailing wage for fabricating concrete components in West Virginia, which cannot be guaranteed when steel components are fabricated in other states. When evaluating various materials' benefits in a larger context, the tax revenues and job creation provided by concrete materials are very compelling.

Concrete designs also were aided by changes to state laws approximately nine years ago, which allowed design-build delivery methods to be used. This led to a broader range of concepts and encouragement of innovations that save time and money. In some cases, these designs began as steel designs and were value-engineered into concrete designs.

A number of concrete bridges have been completed as design-build projects, including the Van Metre Ford Bridge, which replaced a historic stone bridge (retained as a pedestrian

The concrete beams of the Coopers Creek Bridge were long and would have been heavy, but the design-build team specified lightweight concrete to both reduce the weight and minimize the crane size.

The Van Metre Ford Bridge (above and below), a design-build project, contains prestressed concrete hybrid bulb tees with a 40-in.-wide bottom flange that allows more prestressing strands to be used.

bridge). The bridge uses a prestressed concrete hybrid bulb tee developed from a Kentucky design, that has a 40-in.-wide bottom flange. The design allows more prestressing strands to be included, providing a shallower depth than is possible with standard girder shapes. This unique bulb-tee cross section creates opportunities where longer spans and higher under-bridge clearances are needed.

The bulb tees were made with 9-ksi concrete, which provided added capacity. Precast producers say they can provide this concrete strength routinely, and WVDOT expects to use it more often now that there is the option of spanning longer distances with a shallower girder to create the largest waterway opening.

Another design-build project, the Coopers Creek Bridge, featured 161-ft 6-in.-long prestressed concrete beams that would have been very heavy so the designers specified lightweight concrete to reduce the weight as well as to minimize the crane size.

These advances are creating more opportunities for concrete designs that help resolve issues and build bridges more quickly and more cost effectively. WVDOT's goal is to encourage innovation and maximize the potential for concrete designs to ensure every creative concept is considered.

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EDITOR'S NOTE

There are two articles about the Design and Construction, respectively, of the East Huntington Bridge. Please see the January-February 1987 and November-December 1987 issues of the PCI Journal.